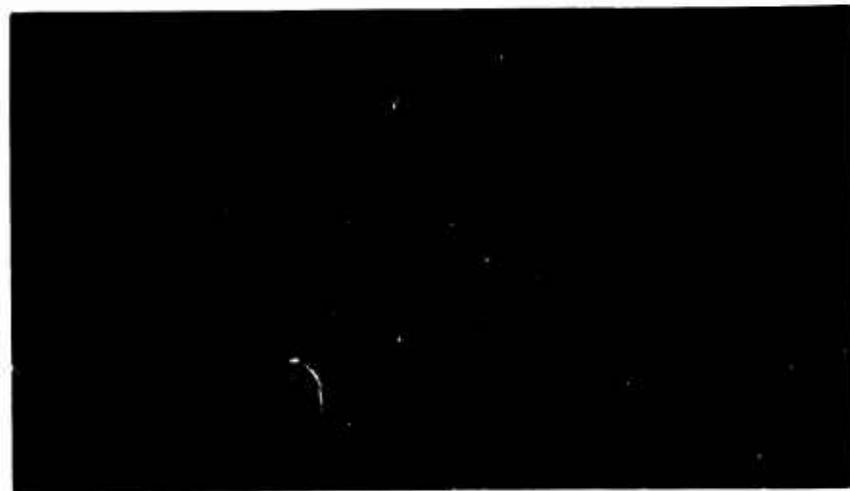


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SYSTEMS RESEARCH MEMORANDUM No. 205

The Technological Institute The College of Arts and Sciences
Northwestern University

NEWS REPORT

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Report prepared for presentation at Columbia University Second Annual
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1. Introduction:

The collection of concepts and relations which we shall examine in this paper may be grouped together under the single name NEWS. This is an acronym for New-Product Early Warning System and is motivated by the "new-product context" in which NEWS was originally conceived. NEWS was developed as a part of the "planning" component in a model called DEMON designed for use in new product marketing at BBDO.^{1/} Via this component, DEMON can supply early warning on those parts of a marketing system which merit attention.

It is important to emphasize that DEMON was designed with NEWS as a separable component. Other components may be inserted in place of NEWS as part of the DEMON system. NEWS may also be used in other contexts. For example, NEWS is available for use as a component in a system for planning media schedules. It will also be useful as a guide in data collection systems that will be required for extending present media scheduling models to dynamic applications. Advertising expenditures might then be related to actual sales via trier-user relations, advertising awareness, and other such intervening variables and relations.

The following sections of this paper will examine some of the concepts and methods NEWS brings into new product marketing and advertising. In later sections we will examine some extensions or modifications of NEWS.

2. NEWS: Basic Concepts and Methods:

NEWS was intended to be separable from other aspects of DEMON. The model was designed so that it would conform as closely as possible to

^{1/} See [5] for further discussion of the "planning" and other components of DEMON. See also [9] and [15.2].

current practice and present data availability. This is to say that the variables and relations were all selected so that they could be assigned operational significance as part of any new product marketing study. This was to be accomplished while synthesizing the NEWS elements and mechanisms that would produce a model that could serve as a guide for subsequent extensions (including data assembly).

Focusing on only the advertising component of new product marketing systems, it is clear that total advertising expenditures (AD \$) delineates one instrumental variable.^{1/} Gross Rating Points^{2/} (GRP), reach, frequency, advertising awareness (AW), triers and users of the product or brand are also variables that are usually considered in the process of planning the advertising component of a new product marketing strategy.

The above variables are related in ways that violate the assumptions underlying^{3/} any use of a single least-squares regression equation. In particular, the usual assumption of independence does not hold and, in fact, some of the variables are actually defined in terms of the others.^{4/}

This kind of difficulty can be overcome in a variety of ways. These include utilizing constrained regressions under known specified relations, or replacing each such set of interdependent variables with a new one in order to eliminate the colinearities that are the source of the trouble. The latter approach is not satisfactory since it eliminates some decision and diagnostic possibilities. The former (i.e., constrained regression)

1/ This is the term used by J. Tinbergen in [14]. (But see also the citation to a memo by R. Frisch on p. 9 of [14].)

2/ See [2] for definitions of these and other terms.

3/ I.e., the so-called Gauss-Laplace-Markoff assumptions as discussed in, e.g., Kempthorne [9].

4/ See the discussion between awareness, triers, and users in Section 3.

possibility is also unsatisfactory because (a) it does not appear to correspond to the situation that is actually observed or (b) it does not provide relations which are readily usable in the usual new product marketing context.

Figure 1 depicts the causal relations which appear to hold. This suggests the use of a "recursive regression system."^{1/} The parts of the NEWS model which we will examine in the present paper exclude the promotion, distribution, usage rate, price, and dollar demand components. Therefore, these components are aggregated in the representation of Figure 1 and only the remaining parts of the diagram correspond to the causal assumptions we are making for the recursive relations between the indicated variables:^{2/}

$$\begin{aligned} \text{GRP} &= f_1 (\text{Adv. \$}) \\ \text{AW} &= f_2 (\text{GRP}) \\ \text{Triers} &= f_3 (\text{AW}) \\ \text{Users} &= f_4 (\text{Triers}) \end{aligned}$$

The variables are defined and these relations are discussed in detail in the immediately following sections. For the present we simply observe that they conform to the ways in which data are usually obtained for insight and decisions in new product marketing management.

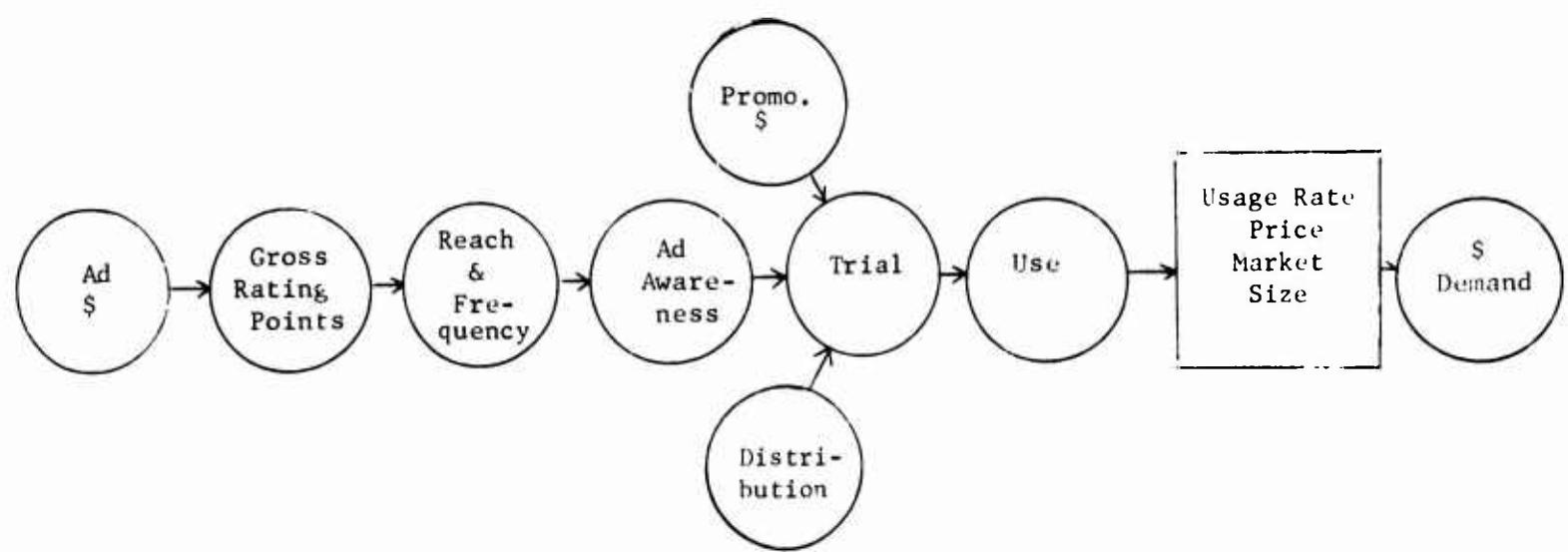
3. NEWS: Basic Relations and Parameters:

The considerations leading to such a recursive system of relations supply general guidance and useful insight. The nature of the relations which are utilized still need to be considered and so do the methods of

1/ See, e.g., Wold [17] and [18]. A discussion of approaches to measuring econometric relations involving simultaneous estimation may be found in [1]. See also [8].

2/ Note, some additional relations and artifactual variables are utilized. These will be described in the next section.

Figure 1



Simple Diagram of NEWS System

estimation and the parameter values. We should emphasize that the latter are regarded as unique to each application. The form of the relations, however, should cover many situations. It would, of course, be premature to claim that the relations used in this paper will cover all situations, but several years of application preceded by an extended period of testing seems to indicate that these relations do hold surprisingly well for new consumer packaged goods products.

We now proceed to develop these relations as follows. The first one is:

$$(1) \text{ Gross Rating Points} = b_1 \times \text{Advertising Dollars}$$

where b_1 is an empirically determined constant and Advertising Dollars is measured cumulatively (in millions of dollars) from time $t = 0$ to the present. Gross Rating Points (GRP), for each media vehicle is the initial rating^{1/} (in per cent) of each specific media vehicle multiplied by the number of insertions in that vehicle. The GRP's for each vehicle in a product's media schedule are summed to yield total GRP for the schedule. This yields a total in which Gross Rating Points are conveniently expressed in thousands when total advertising dollars are expressed in millions.

By means of the next expression we introduce a variable called "virtual reach," which serves as an artifact for reach-frequency considerations. This is defined via the following expression:

$$(2) \text{ VR} = 0.451 (\log_{10} \text{GRP}) - 0.418$$

where VR means virtual reach and $\log_{10} \text{GRP}$ refers to the logarithm of Gross Rating Points taken to the base 10.

The next expression for use in the indicated recursive system is:

1/ The term "rating" refers to the percentage of a target audience reached on a single insertion in a particular media vehicle.

$$(3) AW = b_3 / e^{VR^{-a_3}}$$

where AW refers to "Advertising Awareness," which is measured as the proportion of a target audience who claim to recall^{1/} having seen or heard an advertising message for the brand during some specified time period. b_3 and a_3 are constants, which are determined empirically, while e is the base of the natural logarithms.

The parameters in (3) reflect the relative impact of an advertising budget, etc. Specifically, b_3 is the maximum level of advertising awareness which is approached asymptotically with increasing values of VR (Virtual Reach). The other parameter, a_3 , reflects the rate at which advertising awareness accumulates. Thus, refer to Figure 2 for an illustration. When b_3 remains fixed, as in Figure 2, AW increases with increasing values of a_3 to the right of VR=1. This is to say that higher values of a_3 produce greater advertising awareness in this region. Of course, this purely hypothetical situation is displayed only for purposes of illustration since, in general, the values of b_3 and a_3 will not be independently determined.

The form of the awareness to trial (TR) relation is:

$$(4) TR = a_4 + b_4 (AW).$$

The relation of trial to use is formulated as:

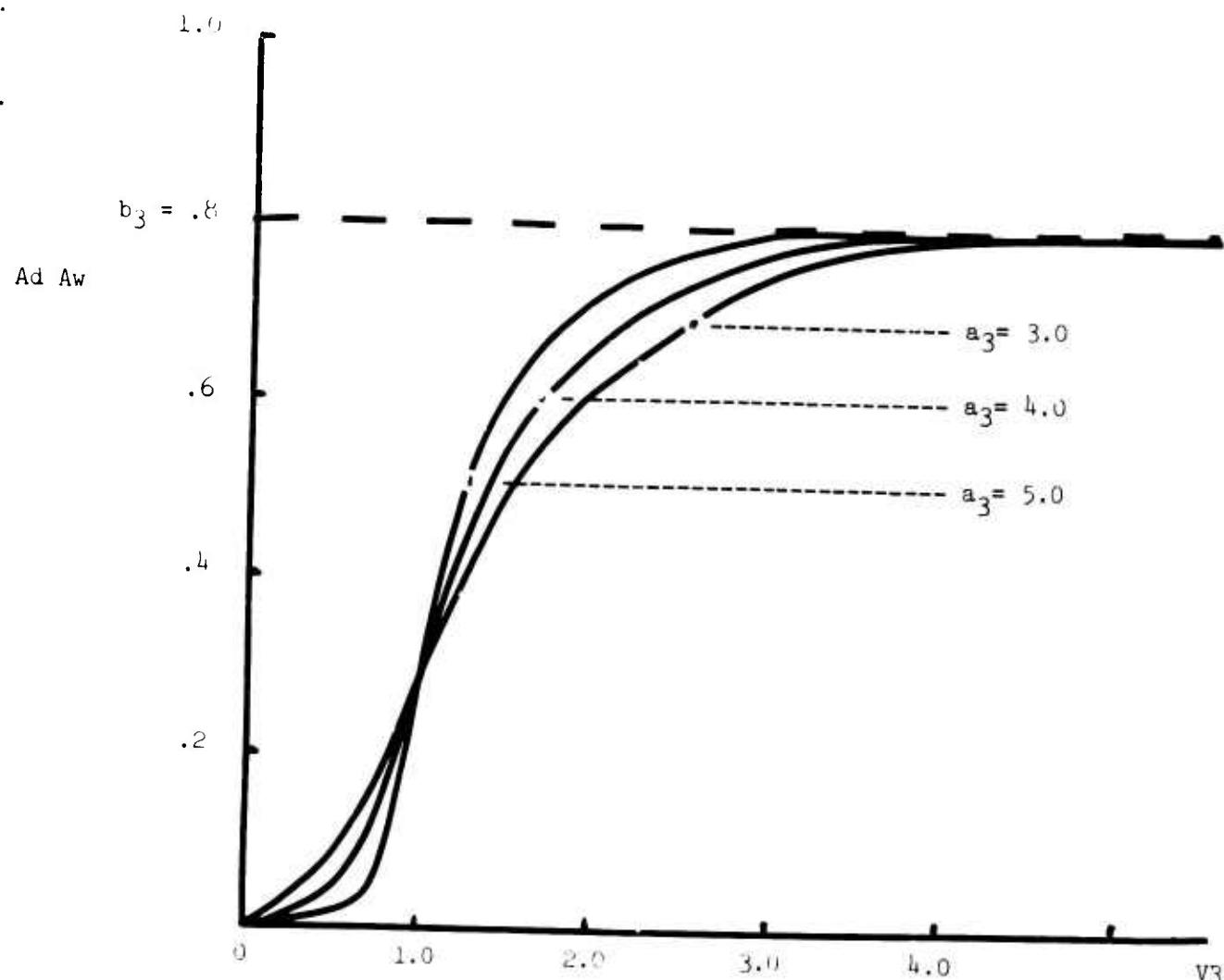
$$(5) Use = b_5 (TR)$$

"Trial" is defined as the proportion of a target population who remember having purchased or otherwise tried the brand within a specified time period. "Use" represents the proportion of a target population who purchased the brand as the most recent purchase made in this product category.^{2/}

^{1/} Usually unaided recall.

^{2/} Note that these definitions differ in some respects from those employed in Learner [10].

Figure 2



Virtual Reach

To

Advertising Awareness Relations

Note that, by definition, $0 \leq b_5 \leq 1$, since b_5 is an estimate of the ratio of triers to users.

Of course some allowance must be made for transient behavior during the period of time that is needed for consumers to familiarize themselves with a product. A "shakedown period" should be incorporated in the experimental design--i.e., before the data collective surveys are initiated--or else the above model will need to be extended to allow for dynamic transient terms.^{1/}

The parameters in (4) provide measures of the selling power of the advertising (along with promotion and distribution)^{2/} in obtaining triers for the brand. Unlike expression (5), the graph of (4) does not necessarily go through the origin since allowance must be made for the effects of promotion and distribution, in producing triers of the brand.^{3/}

We can collect these last interpretations and succinctly summarize them by saying that a_4 and b_4 represent the quality of the advertising, promotion, etc., in producing "triers," while b_5 represents the quality of the product as perceived by the target population relative to their expectations and perceived alternatives.

4. Parameter Estimates: An Illustrative Example

As already noted the parameter values for NEWS will usually need to be determined for each particular application. Data availability and decision possibilities will need to be considered in each such application along with the kind of estimating and testing procedures that are available

1/ This course should be taken when it is believed that these dynamic transient terms could cause different decisions or action recommendations.

2/ See Figure 1.

3/ On occasion negative values of a_4 may be obtained--which suggests a subsequent extension via constrained regressions or related techniques. See, e.g., Chapter X in A. Charnes and W. W. Cooper [4].

in the statistics and economics literature. Pursuit of these latter topics is best reserved for a subsequent paper where they may be dealt with in adequate technical detail. This will then allow us to utilize the present paper to describe a recent application of the NEWS model in evaluating a new product marketing strategy. It will also allow us to examine the possible extensions to other uses that were noted in the opening sections of this paper.

5. Application of NEWS

The NEWS model, as already noted, has been used in a variety of applications both in the U.S. and elsewhere. Rather than simply repeating these results, it might be of interest to report, on an in-process application where NEWS is now being used in analyzing test market data for a new consumer packaged goods product. The following analysis is based on these data.

In Figure 3 we show the relationship between Advertising Expenditures and the obtained Gross Rating Points as estimated from the empirical data for this case. Note that the relationship does conform to the linear model assumed in NEWS. See (1). The corresponding regression equation shows that the media schedule will deliver about one thousand GRP's per million dollars of advertising. This is quite efficient considering the type of media which were acceptable to the brand management.

The next figure (Figure 4) depicts the relationship between GRP's and Awareness. In this case, "total" brand awareness (unaided plus aided) was used as the criterion. The two parameter values $b_3=99\%$ and $a_3=3.0$,

FIGURE 3

Advertising Dollars To Gross Rating Points (GRP's)

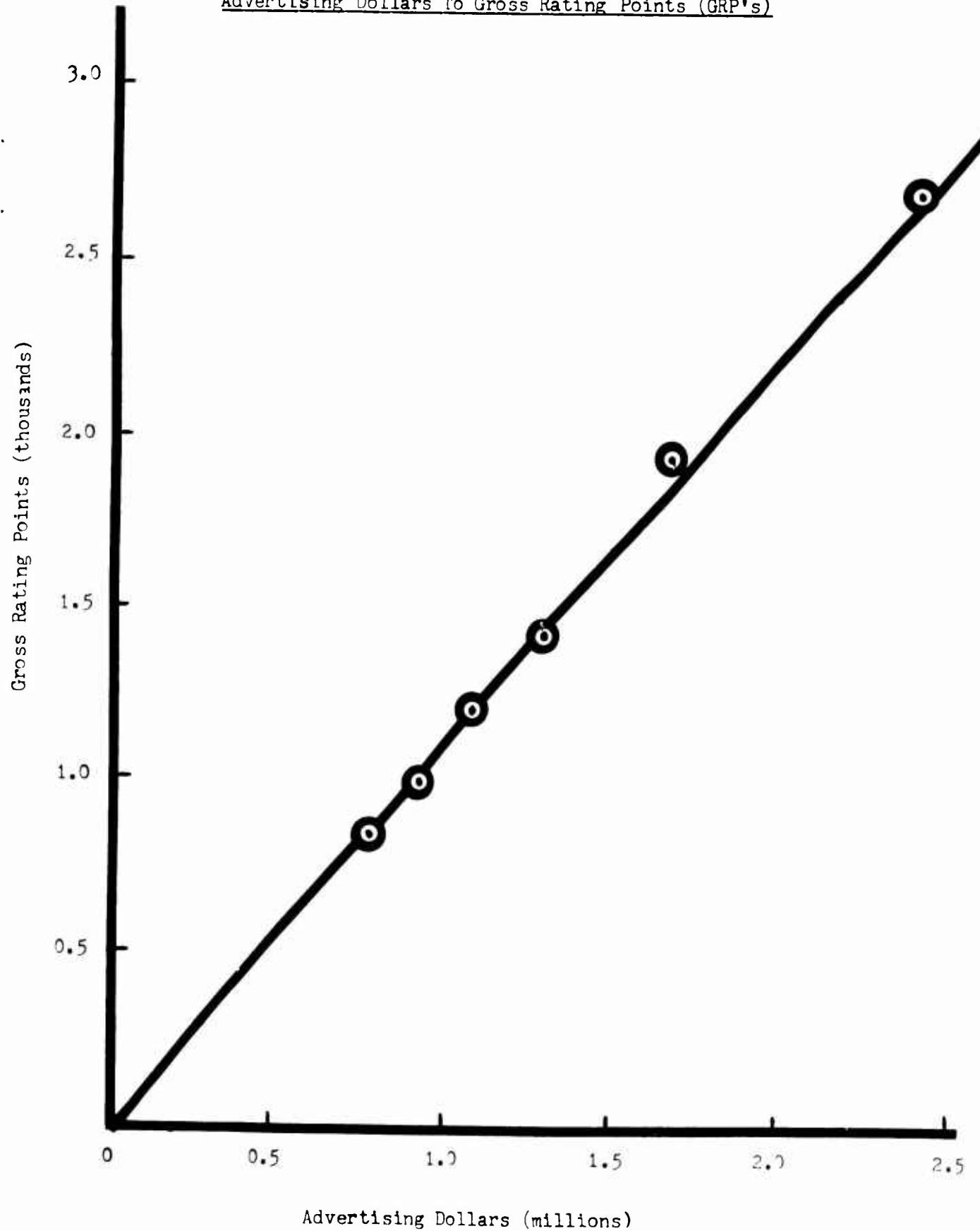
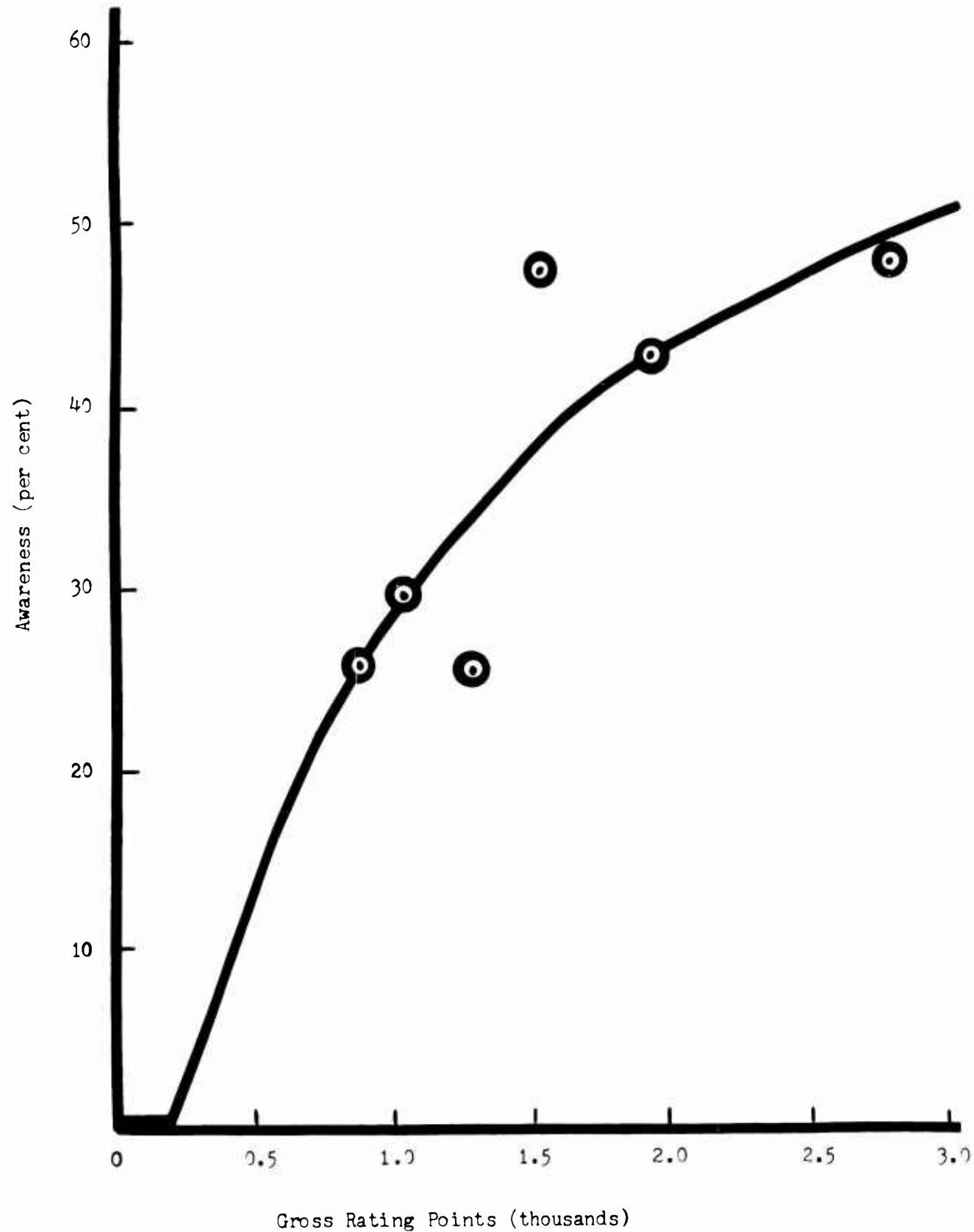


FIGURE 4
GRP's To Awareness



suggest that the advertising is performing quite well in generating brand awareness. See (3) and (2). Projecting this function, a 60% level of awareness is predicted for the end of Year 1 (5000 GRP's; see Figure 5).

The next phase of NEWS involves analyzing the power of the marketing plan, particularly the advertising and promotion, in motivating people to try the brand. Figure 6 shows the Awareness-To-Trial relationship along with the observations used for (4) in this case. The coefficient, $b_4 = .24$, indicates that as awareness increases, about one-fourth of those aware of the brand tried it. It should be noted that the confidence level associated with this regression coefficient is only 75%. While the awareness-to-trial conversion appears to be quite low, additional data might be collected here if the level of confidence is considered inadequate.

The next step in NEWS is an examination of the Trial-To-Use conversion rate. The relationship (5) between trial and use for this brand is shown in Figure 7 along with a plot of the pertinent observations. The conversion rate for this brand was 0.45. (The confidence level is 0.90.) This is a reasonable conversion rate since the average in this class is about 0.50.

The following table summarizes the observed NEWS relations for this particular brand.

<u>ITEM</u>	<u>RELATION</u>
1) Ad Dollars to GRP	$GRP = 1.015 (\text{Ad } \$/1000)$
2) GRP To Awareness	$AW = 99/e^{-3x}$ where $x = 0.451 (\text{LOG}_{10} \text{GRP}) - .418$
3) Awareness To Trial	$TR = 3.2 + .24 (AW)$
4) Trial to Use	$Use = .45 (TR)$

1/ x equals the virtual reach described in Section 3. See expression (2).

FIGURE 5

Gross Rating Points To Awareness

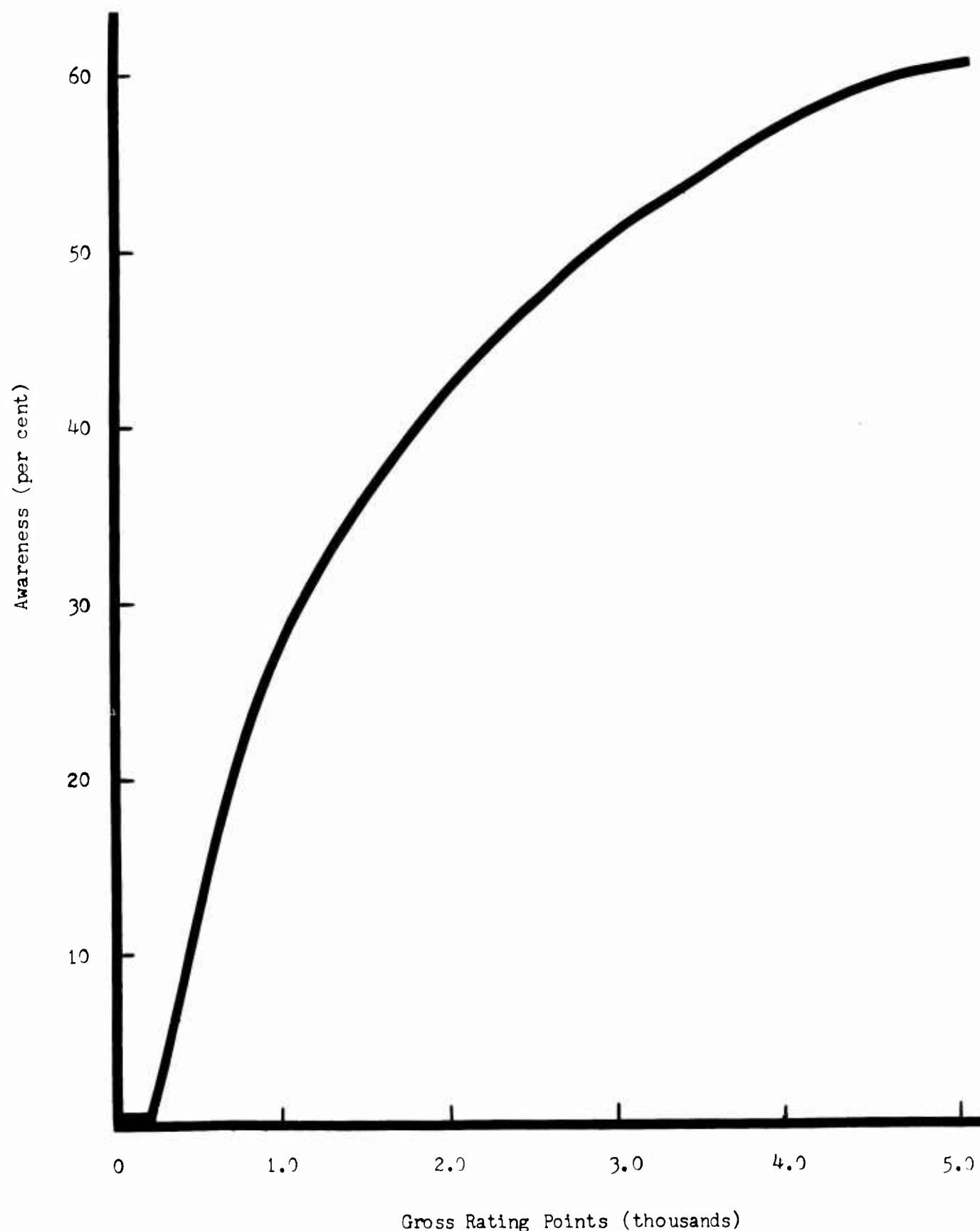


FIGURE 6
Awareness To Trial

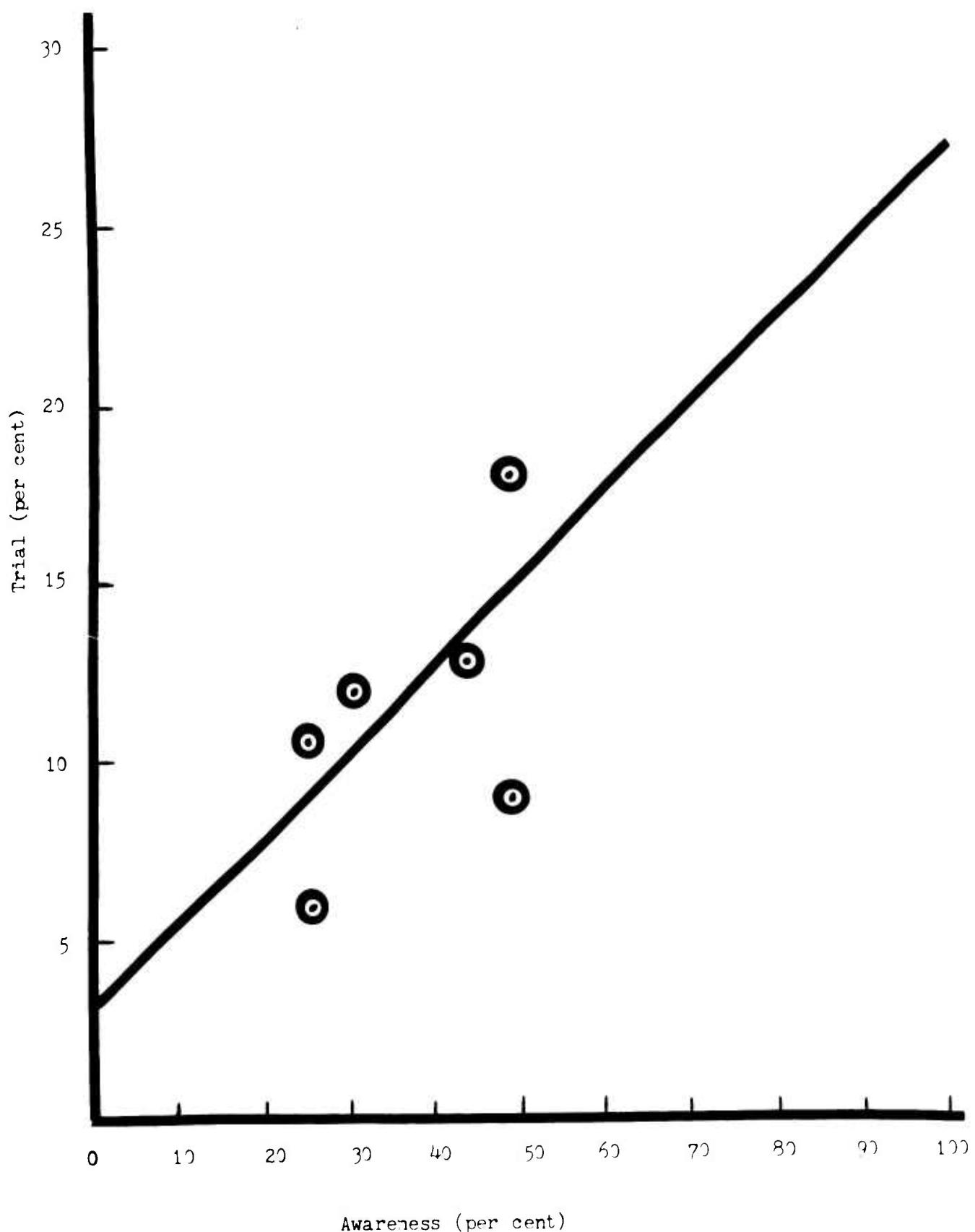
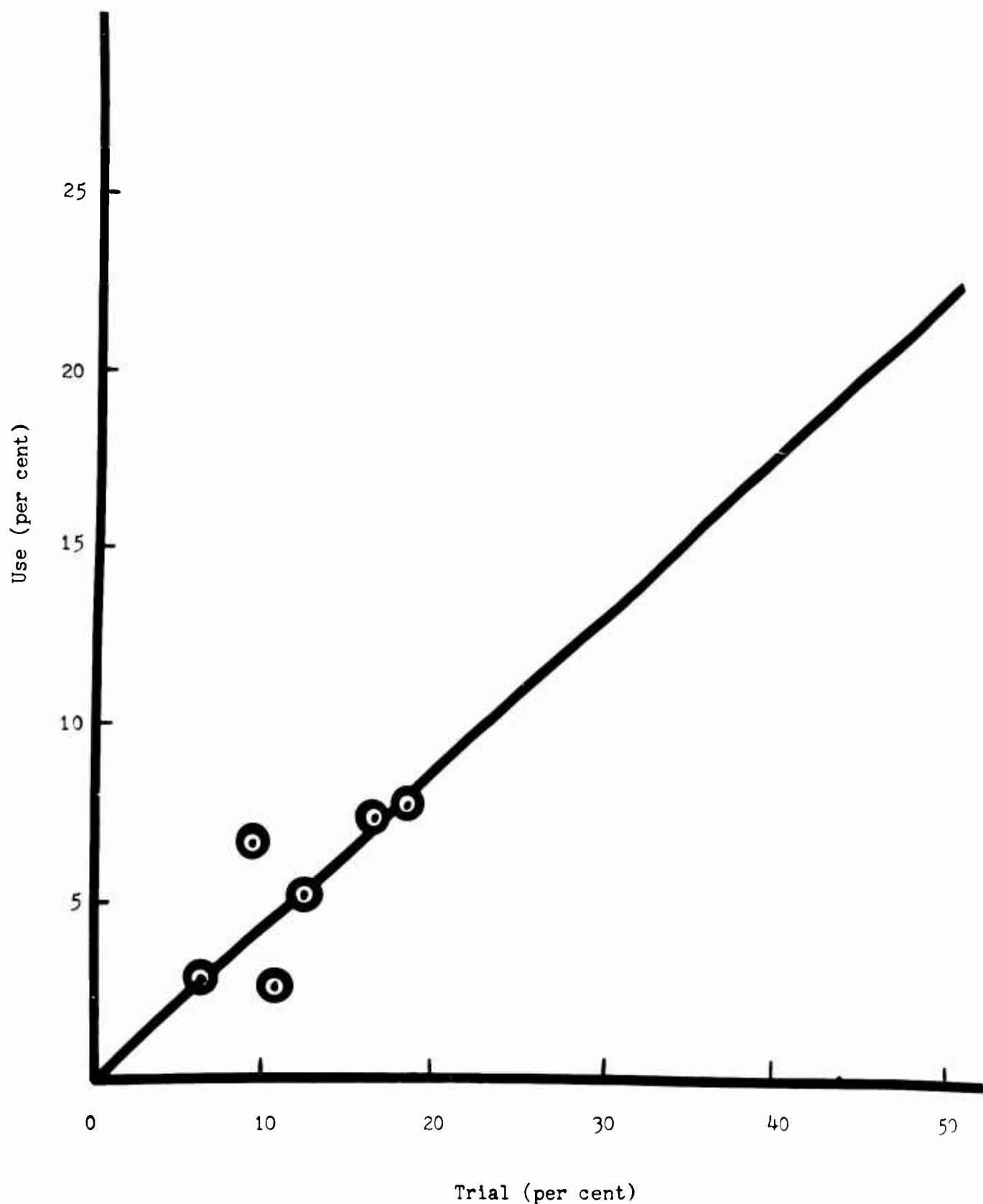


FIGURE 7

Trial To Use



Using the above relations, we can now compare the forecast of the above advertising and marketing effort with goals initially specified by management. The next table compares first year goals with the NEWS forecast.

<u>YEAR I GOALS</u>		<u>NEWS FORECAST</u>
Awareness	75%	60%
Triers	38%	18%
Users	19%	8%

Instead of the desired 19% share at the end of Year I, NEWS forecasts that an 8% share will be obtained. Examination of the parameter values suggested that the advertising was generating a satisfactory level of awareness, but the 75% goal will be difficult to achieve. In any case, alternative advertising might be considered and the possibility of getting more GRP's per dollar should also be investigated.

The major problem appears to lie in obtaining triers. Again, changes in copy approach should be tested. Additional promotions might be implemented.

Finally, certain product characteristics might be changed to increase the Trial-To-Use conversion rate. These involve the brand's price, its quality, the package size, etc.

After consideration of several alternative strategies, the following modifications of the marketing plan were recommended:

- (1) Consider alternative media strategies which provide more GRP's per dollar.
- (2) Develop new copy strategies to generate a higher level of awareness and more triers.

- (3) Introduce an additional promotional event to get more triers.
- (4) Introduce a new package size to be more competitive with other major brands.
- (5) Conduct research to suggest improvements in product performance.

It should be noted that these recommendations involve only minimal additional marketing expenditures. They have all been adopted and are reported here for purposes of the record in evaluating NEWS even though the activities needed to validate these recommendations have not been taken. Presumably they will be taken in the near future, however, so that results will be available and can be reported as part of the process of evaluating NEWS in some subsequent research report. For the present, however, we can observe that NEWS was designed for use as a continuing forecasting and evaluative system, and hence it can at least serve as an effective approach for "tracking" new product introductions.

6. Summary and Conclusions

1. We have now covered NEWS both by general discussion and by an illustrative application. The latter was selected to show how the NEWS system could be employed, on an in process basis, apart from the DEMON context for which it was originally developed. In this case, as in others, too, it can be seen how the specific aspects of data assembly are related to the customary decision variables in a chain that admits of intervention and alteration on strategic dimensions available in the product as well as the advertising programs being employed or available for consideration.

2. We now turn attention to some of the ways in which NEWS might be modified and used as aid (and a guide) in still other areas of potential

application. For example, we might focus on the potential value of NEWS as a way of extending present models and methods for developing media schedules in order to reflect the dynamic considerations that are evidently present when effecting such schedules over a sequence of periods.

An extension that deals with all aspects of media scheduling must ultimately be reflected in a stochastic conditional (decision rule) approach because the schedules utilized in any period will alter the kinds of phenomena that are encountered in succeeding periods. Procedures for assembling data that will help to determine these effects, along with rules for determining whether, and when, such additional studies are to be executed, will need to be incorporated in the model along lines similar to those which are now present in other parts of the DEMON system. See [5] and other references in the bibliography.

3. A great deal can (and should) be accomplished, however, before attempting such conditional stochastic extensions. Here, too, NEWS can provide considerable help. As observed earlier, it already provides insight and aids for an advertising program at a comprehensive aggregate level. Additional features would include a treatment of the media vehicles in explicit detail. Specific quantitative constraints might be imposed on the media selection possibilities -- at least in goal programming fashion^{1/} -- in order to achieve suitable levels of awareness, trial, and use for a particular brand. The NEWS system of estimating would thus become part of a comprehensive media scheduling model. In the meantime it can serve as a guide for the data assembly that must first be undertaken if the

1/ See [6] and see [7] for an example application of goal programming to media scheduling with "inconsistent" requirements. See also [4] Chapter X for a more general discussion.

relations between advertising and sales (and, ultimately, profits) are to form meaningful (rather than misleading) parts of such a model.

Leaving aside considerations such as promotion and distribution which evidently also require treatment as part of a comprehensive model, we can also direct attention to psychological phenomena--such as forgetting, learning, remembering, etc. These will naturally need to be considered as part of a comprehensive media-mix system. Here, too, a period of organized data assembly will be needed if systematic and continuing exploitation of these possibilities are to be secured.

Brand switching and related phenomena are also suggested for examination along the route to such extensions. Information on usage rate--to isolate the heavy, light and average users--also requires attention. Attempts to further identify advertising as distinguished from product properties,^{1/} will make it necessary to replace some of the present NEWS relations with others of a more detailed variety.

In the meantime we can present the NEWS system as a possible contributor toward progress in these directions. A comprehensive model will also naturally point up the need for research on "wear out"^{2/} and related psychological phenomena. The use of sensitivity and evaluator analysis

- 1/ These distinctions are more difficult in the case of new products where the marketing approach and the product (including the price, its physical properties and other phenomena usually assumed as steady-state "givens" in, e.g., economic demand theory) are best regarded as a total package of information wherein alteration produces a new package of information for transmission to consumers.
- 2/ "Wear out" refers to the supposed tendency of an advertising message to lose its power with continued use of the same copy.

routines,^{1/} can be coupled with models of the proposed types which can then be used to determine the kinds of accuracy that will be needed for such "qualitative" data. Thus, it is proposed once more^{2/} that a comprehensive model should tie estimation and prediction together with the evaluations and decisions--rather than treating these as separate functions as is presently done in much current practice in marketing analysis, economic forecasting and company decision making.

We have focused on NEWS as a recursive (causal) regression model. Extensions of the kind we have indicated will evidently require something more. Identification, simultaneous estimation^{3/} and related statistical models and methods will be needed even to accommodate promotion with distribution, sales effort and advertising in a single system. Time series of both a stationary and non-stationary variety are also likely to be encountered en route to some of the other extensions. This in turn is likely to point toward additional research, some of which may involve very fundamental inquiries into mathematics and statistics. This is to the good, of course, insofar as this is used to stimulate progress in these basic sciences and does not, at the same time, bring all progress in applications to a halt. It should be possible to avoid the latter by recourse to suitably devised simulations and heuristics and, indeed, these may also provide insight and guidance for the former as well.

1/ See [15.1] for a discussion of these terms in the context of a model for budgeting advertising.

2/ See [15.1].

3/ See, e.g., [1] and [8].

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